Chapter 4 – Answers to questions (for in-chapter questions)

1  a  Particles from the perfume evaporate, mix with air particles and diffuse away from the wearer.
    b  Particles sublime from the solid into the air without going through a liquid state.

2  a  H₂O molecules which are bumping into and moving around each other.
    b  The pollen grains are being bumped continually by water molecules so they move this way and that way in a random fashion.

3  Because they reflect tiny points of light.

4  If the temperature of the smoke particles rises, then the particles will have more energy and they will move about more rapidly.

5  a  Because the particles are so close together and the forces between them are strong.
    b  The forces between liquid particles are strong enough to hold the particles together, but the particles are still able to move around each other and roll over each other allowing the liquid to adopt a different shape depending on gravity and the shape of its container.
    c  Because the gas molecules are separated by relatively very large distances.
    d  In both solids and liquids the particles are close together and in contact, but in solids they are packed neatly and regularly making them more dense.

6  a  2000 cm³,  b  1333.3 cm³

7  a  \[
    \frac{p}{V}
    \]
    b  \[
    \frac{p}{V}
    \]
    c  \[
    \frac{pV}{T}
    \]

8  a  \[
    \frac{pV}{T}
    \]
    b  \[
    \frac{pV}{T}
    \]

9  a  it increases,  b  more,  c  it increases,  d  more
10  a  They will not vaporise in the graduated syringe.
   b  To prevent liquid vaporising before it is injected into the graduated syringe.
   c  Any two of the following.
      Incomplete vaporisation of the liquid inside the graduated syringe.
      Vaporisation of liquid before injection into the graduated syringe.
      Failure to maintain the graduated syringe at 100 °C.
   d  i  Relative masses  C : H : Br = 22.0 : 4.6 : 73.4
      Relative moles  C : H : Br = \( \frac{22.0}{12} : \frac{4.6}{1} : \frac{73.4}{79.9} \)
       = 1.83 : 4.6 : 0.92
       = 1.83 \cdot 0.92 : 4.6 \cdot 0.92
       = 2 : 5 : 1

      Empirical formula = C\(_2\)H\(_5\)Br
   ii  Molecular formula = C\(_2\)H\(_5\)Br
   iii  Accurate \( M_r = (2 \times 12.0) + (5 \times 1.0) + 79.9 = 108.9 \)

11  a  10,  b  carbon atoms
   c  They are hydrogen atoms around which the electron density is too low to register.

12  a  malleable,  b  malleable,  c  low density,
    d  malleable and good electrical conductivity,  e  good heat conduction,
    f  low density

13  a  Because it forms a strong, coherent, non-porous layer of Al\(_2\)O\(_3\).
    b  It has a lower density and it is a better conductor.

14  a  The smaller one (top left and bottom right)
    b  0.275 nm
    c  i  0.119 nm  ii  0.156 nm

15  a  Because the ions in the liquid can move to the electrodes of opposite charge and transfer charge through the liquid.
    b  Because the ions can only vibrate in the solid around fixed positions. They cannot move through the solid.

16  Because the ions are attracted towards the regions of opposite charge as a result of dipoles on the water molecules.
17  a Because diamond has a regular tetrahedral arrangement of carbon atoms in which each atom is bonded to four others by strong covalent bonds.
   b 4,   c No

18  a Graphite in a soft pencil can act as a lubricant, but will not spoil any material near the zip or lock in a way that oil might.
   b The moving parts of machinery may be hot enough to set the oil alight which would not happen with graphite.
   c The higher the proportion of graphite, the softer the pencil ‘lead’.

19  a 3,   b 1–
   c Because the layers of silicate in talc move smoothly between your fingers when talcum powder is rubbed.
   d Because mica is composed of a sheet silicate.

20  a 4,   b 4,   c 12

21  a Each carbon atom in C\textsubscript{60} has only 3 covalent bonds to nearest neighbours and one non-bonded electron like the carbon atoms in graphite.
   b 3
   c In graphite, the non-bonded electrons are delocalised over an entire layer in the graphite structure so they can move through the whole sample of graphite. In contrast, the non-bonded electrons in C\textsubscript{60} are delocalised only over an individual C\textsubscript{60} molecule. They cannot move from that C\textsubscript{60} molecule to another molecule or material.

22  a Cu,   b NaI,   c Si,   d NH\textsubscript{3},   e Xe,   f NH\textsubscript{3}